

Table A6-1

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
56A	1) Establish no action extraction scenario. (No action extraction scenario includes normal pumping from 19th St. #1 and #2 wells for 5-year period between January 1986 through December 1990.)	1) Input files from run 55A were renamed to run 56A (no modification to run 56A file; i.e., run 56A is identical to run 55A).	1) Simulation converged with 0.01 % water balance discrepancy. 2) Paths of imaginary particles define the no action extraction scenario. 3) These input files can be used as baseline input file to incorporate extraction scenario in future model.
56B	1) Effect on plume capture due to increased pumpage in 19th St. #1 and #2 wells from January 1991 onward.	1) Input files from run 56A were modified to include: - 19th St. #1 and #2 well, pumping each @ 2000 gpm from 01/91 onward.	1) Simulation converged with 0.01 % water balance discrepancy. 2) Most of the imaginary particles were not captured and only a few particles were captured by 19th St. #1 and #2 wells. 3) These changes will be incorporated into future versions of the model.
57A	1) Effect on plume capture due to pumping in Perris St. and 9th St. wells.	1) Input files from run 56B were modified to include: - 19th St. #1 and #2 wells pumping each @ 2000 gpm from 01/91 onward. - Perris St. and 9th St. wells pumping @ 4000 and 4500 gpm, respectively, from 01/91 onward.	1) Simulation converged with 0.00% water balance discrepancy. 2) Number of the introduced imaginary particles were removed by 19th St., Perris St. and 9th St. wells. A few imaginary particles near the San Jacinto Fault boundary and many imaginary particles introduced north of Perris St. and 9th St. wells were not captured. 3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
58A	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Input files from run 56B were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 3 new extraction wells pumping @ 1000, 2000, and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01% water balance discrepancy.  2) Most of the introduced imaginary particles were removed except a few near south and one north of the new extraction well cluster.  3) These changes will be incorporated into future versions of the model.
58B	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Pumping in run 58B was exactly the same as for run 58A except 2 new extraction wells were moved diagonally one cell outward. Location of center extraction well was not changed.  2) Input files from run 56B were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 3 new extraction wells pumping @ 1000, 2000, and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01% water balance discrepancy.  2) Most of the introduced imaginary particles were removed except a few near south of extraction well cluster, and a few particles escaped through the gap between 2 new extraction wells.  3) These changes will be incorporated into future versions of the model.
58C	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of new extraction wells was the same as in run 58B. Pumping in run 58C was same as in run 58B, but pumping in one extraction well was increased to 1500 gpm.  2) Input files from run 58B were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 3 new extraction wells pumping @ 1000, 2000, and 1500 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.00% water balance discrepancy.  2) Most of the introduced imaginary particles were removed except a few near south of extraction well cluster, and a few particles escaped through the gap between 2 new extraction wells.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
58D	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of new extraction wells was the same as in run 58C. Pumping in run 58D was same as in run 58C, but pumping in one extraction well was reduced from 2000 gpm to 1500 gpm.  2) Input files from run 58C were modified to include: <ul style="list-style-type: none"> <li>- 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward.</li> <li>- 3 new extraction wells pumping @ 1000, 1500, and 1500 gpm.</li> <li>- No pumping from Baseline wells.</li> </ul>	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except a few near south of extraction well cluster, and a few particles escaped through the gap between 2 new extraction wells.  3) These changes will be incorporated into future versions of the model.
58E	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Pumping in run 58E was exactly the same as in run 58A except all three new extraction wells were moved diagonally one cell toward northwest direction.  2) Input files from run 58A were modified to include: <ul style="list-style-type: none"> <li>- 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward.</li> <li>- 3 new extraction wells pumping @ 1000, 2000, and 1000 gpm.</li> <li>- No pumping from Baseline wells.</li> </ul>	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except a few near south of extraction well cluster, and one particle north of extraction well cluster escaped capture.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
59A	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of 3 new extraction wells were same as in run 58A. Pumping in run 59A was same as in run 58A. But 4th new extraction well was added to run 59A pumping @ 1000 gpm.  2) Input files from run 58A were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 4 new extraction wells pumping @ 1000, 2000, 1000 and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.00% water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one imaginary particle south of and north of extraction well cluster.  3) These changes will be incorporated into future versions of the model.
59B	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59B were same as in run 59A except pumping from one extraction well was reduced from 2000 to 1000 gpm.  2) Input files from run 59A were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 4 new extraction wells pumping @ 1000, 1000, 1000 and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01% water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one in the north of and a few in the south of extraction well cluster. One imaginary particle between the gap of two extraction wells escaped.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
59C	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59C were same as in run 59B except 19th #1 and #2 wells were turned-off from 01/91 onward.  2) Input files from run 59B were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1000, 1000, 1000 and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01 % water balance discrepancy.  2) A few of the introduced imaginary particles were removed. A few in the south of and in the north of extraction well cluster escaped. Also a few imaginary particles between the gaps of three extraction wells escaped.  3) These changes will be incorporated into future versions of the model.
59D	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59D were same as in run 59B except pumping from one extraction well was increased from 1000 to 1500 gpm.  2) Input files from run 59B were modified to include: - 19th St. #1 and #2 wells pumping each @ 1500 gpm from 01/91 onward. - 4 new extraction wells pumping @ 1000, 1500, 1000 and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.00% water balance discrepancy.  2) A few of the introduced imaginary particles were removed. A few in the south of and in the north of extraction well cluster escaped. Also a few imaginary particles between the gaps of three extraction wells escaped.  3) These changes will be incorporated into future versions of the model.
59E	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59E were same as in run 59D except 19th St. #1 and #2 wells were turned off from 01/91 onward.  2) Input files from run 59D were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1000, 1500, 1000, and 1000 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except two particles south of and north of extraction well cluster.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
59F	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59F were same as in run 59E except pumping from two extraction wells was increased from 1000 to 1500 gpm.  2) Input files from run 59E were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1500, 1500, 1000, and 1500 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one to the south of extraction well cluster and two imaginary particles between the gap of two extraction wells escaped.  3) These changes will be incorporated into future versions of the model.
59G	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59G were same as in run 59F except pumping from one extraction well was increased from 1000 to 1500 gpm.  2) Input files from run 59F were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1500, 1500, 1500, and 1500 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.00 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one between the gap of two extraction wells.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
59H	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59H were same as in run 59G except pumping from two extraction wells was modified as 1500 to 1200 and 1500 to 1700 gpm.  2) Input files from run 59G were modified to include: <ul style="list-style-type: none"> <li>- 19th St. #1 and #2 wells were turned off from 01/91 onward.</li> <li>- 4 new extraction wells pumping @ 1200, 1500, 1700, and 1500 gpm.</li> <li>- No pumping from Baseline wells.</li> </ul>	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one north of the extraction well cluster.  3) These changes will be incorporated into future versions of the model.
59I	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59I were same as in run 59H except pumping from one extraction well was increased from 1200 to 1300 gpm.  2) Input files from run 59H were modified to include: <ul style="list-style-type: none"> <li>- 19th St. #1 and #2 wells were turned off from 01/91 onward.</li> <li>- 4 new extraction wells pumping @ 1300, 1500, 1700, and 1500 gpm.</li> <li>- No pumping from Baseline wells.</li> </ul>	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were removed except one north of the extraction well cluster.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
59J	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 59J were same as in run 59I except pumping from one extraction well was increased from 1300 to 1500 gpm.  2) Input files from run 59I were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1500, 1500, 1700, and 1500 gpm. - No pumping from Baseline wells.	1) Simulation converged with 0.00% water balance discrepancy.  2) All the introduced imaginary particles were captured by the extraction wells.  3) These changes will be incorporated into future versions of the model.
60A	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 60A were same as in run 59J except Baseline wells were turned on.  2) Input files from run 59J were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1500, 1500, 1700, and 1500 gpm. - Baseline wells were pumping from 01/91 onward.	1) Simulation converged with 0.01% water balance discrepancy.  2) All the introduced imaginary particles were captured by the extraction wells. Plume capture in run 59J was not affected by pumping of Baseline wells.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
60B	1) Evaluate preliminary extraction well placement and extraction volume to establish plume capture.	1) Location of extraction wells and pumping in run 60B were same as in run 60A except pumping from extraction wells was reduced during the quarter, keeping 1500, 1500, 1700, and 1500 gpm as maximum.  2) Input files from run 60A were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping maximum @ 1500, 1500, 1700, and 1500 gpm with reduced pumping during the quarters. - Baseline wells were pumping from 01/91 onward.	1) Simulation converged with 0.01 % water balance discrepancy.  2) Most of the introduced imaginary particles were captured except one particle south of and north of the extraction well cluster. One particle between the gap of two extraction wells appeared to escape.  3) These changes will be incorporated into future versions of the model.
61A	1) Evaluate preliminary injection well placement to evaluate end-use of the treated water.	1) Location of extraction wells and pumping in run 61A were same as in run 59J except 8 new injection wells added in this run.  2) Input files from run 59J were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping @ 1500, 1500, 1700, and 1500 gpm. - No pumping from baseline wells. - 8 new injection wells each injecting @ 775 gpm.	1) Simulation converged with 0.01 % water balance discrepancy.  2) All the introduced imaginary particles were captured by the extraction wells except 2 particles near one extraction well (northernmost outer one) and 2 particles between 2 new extraction wells in the southern part of extraction well cluster.  3) These changes will be incorporated into future versions of the model.

Table A6-1 (Cont'd.)

SUMMARY OF EXTRACTION SCENARIO RUNS FOR MUSCOY PLUME OU

Runs	Objective(s)	Input Files Used and Revisions	Summary of Results
61B	1) Evaluate preliminary injection well placement to evaluate end-use of the treated water	1) Location of extraction wells and pumping in run 61B were same as in run 61A except the location of injection wells were changed in run 61B.  2) Input files from run 61A were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping maximum @ 1500, 1500, 1700, and 1500 gpm with reduced pumping during the quarters. - No pumping from baseline wells. - 8 new injection wells each injecting @ 775 gpm.	1) Simulation converged with 0.01 % water balance discrepancy.  2) All the introduced imaginary particles were captured except 2 particles near the extraction well (northernmost outer one).  3) These changes will be incorporated into future versions of the model.
61C	1) Evaluate preliminary injection well placement to evaluate end-use of the treated water.	1) Location of extraction wells and pumping in run 61B were same as in run 61A except the location of injection wells were changed in run 61B.  2) Input files from run 61A were modified to include: - 19th St. #1 and #2 wells were turned off from 01/91 onward. - 4 new extraction wells pumping maximum @ 1500, 1500, 1700, and 1500 gpm with reduced pumping during the quarters. - No pumping from baseline wells. - 8 new injection wells each injecting @ 775 gpm.	1) Simulation converged with 0.01 % water balance discrepancy.  2) All the introduced imaginary particles were captured by the extraction wells.  3) These changes will be incorporated into future versions of the model.

- Notes:
- All the runs were simulated for a period of 35 years starting from January 1986 through December 2020.
  - New extraction wells were assumed to begin pumping from 6th year of simulation (i.e., pumping in extraction wells simulated for 30-year period starting from January 1991 through December 2020).
  - All the extraction scenarios included normal (or actual) pumping from 19th St. No. 1 and No. 2 wells for first 5-year period between January 1986 through December 1990.
  - The Baseline Feeder wellfield includes Perris St. and 9th St. City of San Bernardino wells.
  - See Figure A6-1 for the location of the extraction area.

Table A6-2

EXTRACTION SCENARIOS FOR MUSCOY PLUME OU

Extraction Scenario	Extraction Area	Pumping Rate	Total Pumping (gpm)	Results
No. 1 (Run 57A)	19th St. No. 1 and No. 2 wells  Perris St. well  9th St. well	Each @ 2000 gpm from 01/91 onward.  4000 gpm from 01/91 onward.  4500 gpm from 01/91 onward.	12,500	A number of the introduced imaginary particles were removed by 19th St., Perris St. and 9th St. wells. A few imaginary particles near the San Jacinto Fault boundary and many imaginary particles introduced north of Perris St. and 9th St. wells were not captured.
No. 2 (Run 56A)	19th St. No. 1 and No. 2 wells	Normal (or actual) pumping rates from 01/86 onward and repeated in 5-year cycles.	--	Most imaginary particles were not captured.
No. 3 (Run 58D)	19th St. No. 1 and No. 2 wells  3 new extraction wells	Each @ 1500 gpm from 01/91 onward.  1000, 1500 & 1500 gpm.	7,000	Most of the introduced imaginary particles were removed except a few near south of the extraction well cluster, and a few particles escaped through the space between 2 new extraction wells.

Table A6-2 (Cont'd.)

EXTRACTION SCENARIOS FOR MUSCOY PLUME OU

Extraction Scenario	Extraction Area	Pumping Rate	Total Pumping (gpm)	Results
No. 4 (Run 58E)	19th St. No. 1 and No. 2 wells  3 new extraction wells	Each @ 1500 gpm from 01/91 onward.  1000, 2000 & 1000 gpm.	7,000	Most of the introduced imaginary particles were removed except a few near south of extraction well cluster, and one particle north of extraction well cluster.
No. 5 (Run 59D)	19th St. No. 1 and No. 2 wells  4 new extraction wells	Each @ 1500 gpm from 01/91 onward.  1000, 1500, 1000 & 1000 gpm.	7,500	Only a few of the introduced imaginary particles were removed. A few in the south of and in the north of extraction well cluster escaped. Also, a few imaginary particles escaped between the four extraction wells.
No. 6 (Run 59J)	4 new extraction wells	1500, 1500, 1700 & 1500 gpm.	6,200	All the introduced imaginary particles were captured by the extraction wells.
No. 7 (Run 60A)	4 new extraction wells  Perris St. well and 9th St. well	1500, 1500, 1700 & 1500 gpm.  Normal pumping rate from 01/91 through 12/93. Normal yearly pumping rate of 93 was repeated every year from 01/94.	7,417 - 10,770	All the introduced imaginary particles were captured by the extraction wells. Plume capture in extraction scenario no. 6 was not affected by pumping from the Baseline Feeder wellfield.

Table A6-2 (Cont'd.)

EXTRACTION SCENARIOS FOR MUSCOY PLUME OU

Extraction Scenario	Extraction Area	Pumping Rate	Total Pumping (gpm)	Results
No. 8 (Run 60B)	4 new extraction wells  Perris St. well and 9th St. well	Seasonally varying pumping in each quarter of a year with maximum pumping during 4th quarter @ 1500, 1500, 1700 & 1500 gpm.  Normal pumping rate from 01/91 through 12/93. Normal yearly pumping rate of 93 was repeated every year from 01/94.	5,495 - 10,770	Most of the introduced imaginary particles were captured except one particle south of and north of the extraction well cluster. One particle escaped between the four extraction wells.
No. 9 (Run 61C)	4 new extraction wells  8 new injection wells	1500, 1500, 1700, & 1500 gpm  775 gpm for each injection well	6,200 (pumping) 6,200 (injection)	All the introduced imaginary particles were captured by the extraction wells. An end-use alternative involved injecting treated groundwater in two injection regions.

Notes:

- All the runs were simulated for a period of 35 years starting from January 1986 through December 2020.
- New extraction wells were assumed to begin pumping from 6th year of simulation (i.e., pumping in extraction wells simulated for 30-year period starting from January 1991 through December 2020).
- All the extraction scenarios included normal (or actual) pumping from 19th St. No. 1 and No. 2 wells for first 5-year period between January 1986 through December 1990.
- The Baseline Feeder wellfield includes Perris St. and 9th St. City of San Bernardino wells.
- Total pumping represents combined pumping rates from all extraction areas in a scenario. It also represents the constant pumping rate at any time starting from January 1991.
- The range of total pumping shown for extraction scenarios 7 and 8 represents seasonal fluctuations during quarters of a year starting in 1993. Maximum pumpage rates occur during the fourth quarter and minimum pumpage rates occur during the first quarter.
- See Figure A6-1 for the location of the extraction area.

- 1           ■ Evaluate the influence of existing municipal supply wells within the Muscoy Plume OU and  
2           the possibility of their use as extraction areas for the Muscoy Plume OU.

3           Extraction scenario no. 2 was simulated for 35 years using just the existing water-supply wells in the site,  
4           including 19th Street wellfield but excluding the Baseline Feeder wellfield. Extraction scenario nos. 3  
5           through 8 were simulated to determine the optimal extraction rate from the new extraction wells and the  
6           19th Street and the Baseline Feeder wellfields. These scenarios also intended to evaluate the optimal  
7           location of the new extraction well areas. The new extraction well areas were located in the  
8           downgradient edge of the Muscoy Plume OU.

### 9           3.2 RESULTS OF THE EXTRACTION SCENARIOS

10          Computer programs for the simulation of each extraction scenario were executed as follows:

- 11           ■ MODFLOW was run for each extraction scenario to simulate flow conditions of 35 years (or  
12           140 stress periods) starting from January 1986 to December 2020.
- 13           ■ The results from MODFLOW runs were used as input to run PATH3D<sup>®</sup> to create imaginary  
14           particle pathlines.
- 15           ■ The output files from PATH3D<sup>®</sup> were used in SURFER<sup>®</sup> to produce plots of head contours,  
16           pathlines of imaginary particles, and locations of extraction areas.

17          To create imaginary particles, three sets of imaginary particles (a total of 54) were used in PATH3D<sup>®</sup>.  
18          Set No. 1 contained seventeen imaginary particles that were placed near the northern portion of the  
19          Muscoy Plume OU along a northeast-southwest transect. Set No. 2 contained eighteen imaginary  
20          particles that were placed approximately half-way between the northern portion of the Muscoy Plume OU  
21          and the 19th Street wellfield along a northeast-southwest transect. Set No. 3 contained 19 particles that  
22          were placed just south of the 19th Street wellfield along a northeast-southwest transect. Locations of the  
23          imaginary particles are shown in Table A6-3.

24          The pathline of an imaginary particle produced by PATH3D<sup>®</sup> represents movement of groundwater in  
25          the aquifer with time. Because the contaminants (TCE and PCE) move with the groundwater, the  
26          imaginary particle pathline also represents the movement of contaminants in the aquifer with time.  
27          Therefore, the pathlines of the 54 imaginary particles placed, as described before, in the plume represent  
28          the movement of contaminants in the Muscoy Plume OU. Effectiveness of an extraction scenario was  
29          evaluated based on the capture of imaginary particles by the extraction wells. Pumping details and results  
30          of the extraction scenarios are presented below.

#### 31          3.2.1 Extraction Scenario No. 1

32          Model runs 56A, 56B, and 57A were conducted to evaluate the ability of existing wellfields to control  
33          contaminant migration in the Muscoy Plume OU. The extraction scenario run known as the "no action"  
34          scenario (Run 57A) is discussed in this subsection.

Table A6-3

IMAGINARY PARTICLE LOCATIONS FOR EXTRACTION SCENARIOS

Particle(s)	Model Cell (i,j,k)	Particle(s)	Model Cell (i,j,k)
Set 1			
1	(31,7,2)	10	(27,12,2)
2	(31,8,2)	11	(26,12,2)
3	(30,8,2)	12	(26,13,2)
4	(30,9,2)	13	(25,13,2)
5	(29,9,2)	14	(25,14,2)
6	(29,10,2)	15	(24,14,2)
7	(28,10,2)	16	(24,15,2)
8	(28,11,2)	17	(23,15,2)
9	(27,11,2)		
Set 2			
18	(35,10,2)	27	(30,14,2)
19	(34,10,2)	28	(30,15,2)
20	(34,11,2)	29	(29,15,2)
21	(33,11,2)	30	(29,16,2)
22	(33,12,2)	31	(28,16,2)
23	(32,12,2)	32	(28,17,2)
24	(32,13,2)	33	(27,17,2)
25	(31,13,2)	34	(27,18,2)
26	(31,14,2)	35	(26,18,2)
Set 3			
36	(38,15,2)	46	(33,20,2)
37	(38,16,2)	47	(33,21,2)
38	(37,16,2)	48	(32,21,2)
39	(37,17,2)	49	(32,22,2)
40	(36,17,2)	50	(31,22,2)
41	(36,18,2)	51	(31,23,2)
42	(35,18,2)	52	(30,23,2)
43	(35,19,2)	53	(30,24,2)
44	(34,19,2)	54	(29,24,2)

Table A6-3 (Cont'd.)

IMAGINARY PARTICLE LOCATIONS FOR EXTRACTION SCENARIOS

Particle(s)	Model Cell (i,j,k)	Particle(s)	Model Cell (i,j,k)
45	(34,20,2)		

1 The input data (including quarterly well pumpage) and boundary conditions used in the calibration of the  
2 transient-state flow model (from Run 55A) were applied to Run 57A for the first 5 years of the  
3 simulation. These conditions were repeated in 5-year cycles for 30 years. The existing municipal supply  
4 wells, which were pumping between January 1986 through December 1990, were used through the 35-  
5 year simulation. Table A6-4 lists the locations of the existing municipal supply wells and their pumping  
6 rates.

7 Extraction scenario no. 1 consisted of extraction from the 19th Street and Baseline Feeder wellfields.  
8 The extraction from the 19th Street wellfield was as follows:

- 9       ■ For the first 5-year period between January 1986 to December 1990, actual pumping rates  
10       were used; and
- 11       ■ For the next 30-year period, constant daily pumping rate of 2,000 gpm from each of the 19th  
12       Street #1 and #2 wells was considered.

13 The 30-year period pumping rates represented an increased pumping compared to the normal pumping  
14 rate. Based on a report by Geoscience 1990, the following extraction was considered for the Baseline  
15 Feeder wellfield:

- 16       ■ No pumping for the first 5-year period; and
- 17       ■ For the next 30-year period, constant daily pumping rate of 4,000 gpm and 4,500 gpm from  
18       Perris Street and 9th Street wells, respectively.

19 Table A6-5 lists the MODFLOW, PATH3D, and SURFER files associated with extraction scenario no.  
20 1 (or Run 57A). Figures A6-2 and A6-3 show the head contours and pathlines of imaginary particles for  
21 the end of the 35-year simulations for layers 1 and 2, respectively. A few imaginary particles were  
22 captured by the existing wellfields. A few imaginary particles near the San Jacinto Fault and many  
23 particles in the southern portion of the Muscoy Plume OU were not captured.

24 Based on the results of extraction scenario 1, the 19th Street wellfield (municipal supply wells no. 1 and  
25 no. 2 near 19th and Flores Streets) appeared to capture most of the nearby imaginary particles. However,  
26 most of the particles near the Baseline Feeder wellfield were not captured.

27 At the present time, the groundwater contamination is approximately 10,000 feet (1.9 miles) long  
28 measured from the northern portion of the Muscoy Plume OU (Figure A6-4). It is approximately 8,000  
29 feet (1.5 miles) wide at its widest point adjacent to the southwest edge of Shandin Hills. Based on the  
30 positions of the imaginary particles and assuming no retardation of the contaminant velocities, the extent  
31 of the contamination will be approximately 18,000 feet (3.4 miles) long from the northern portion of the  
32 Muscoy Plume OU (Figure A6-4) after 35 years of migration. It will be approximately 8,000 feet (1.5  
33 miles) wide at its widest point adjacent to the southwest edge of Shandin Hills. Therefore, according to  
34 the results of the project flow model as shown in Figures A6-2 and A6-3, the contaminant plume could  
35 be expected to migrate approximately 8,000 feet (1.5 miles) downgradient in 35 years.

Table A6-4

**EXTRACTION AREA LOCATIONS & PUMPING RATES  
FOR EXTRACTION SCENARIO NO. 2 (RUN 57A)**

Extraction Area	Model Cell (i,j,k)	Pumping Ratio		Pumping Rate (gpm)
		Layer 1	Layer 2	
19th St. No. 1	(35,17,1) (35,17,2)	0.63	0.37	2,000
19th St. No. 2	(35,17,1) (35,17,2)	0.75	0.25	2,000
Perris St.	(43,25,1) (43,25,2)	0.67	0.33	4,000
9th St.	(43,23,1) (43,23,2)	0.67	0.33	4,000

Table A6-5

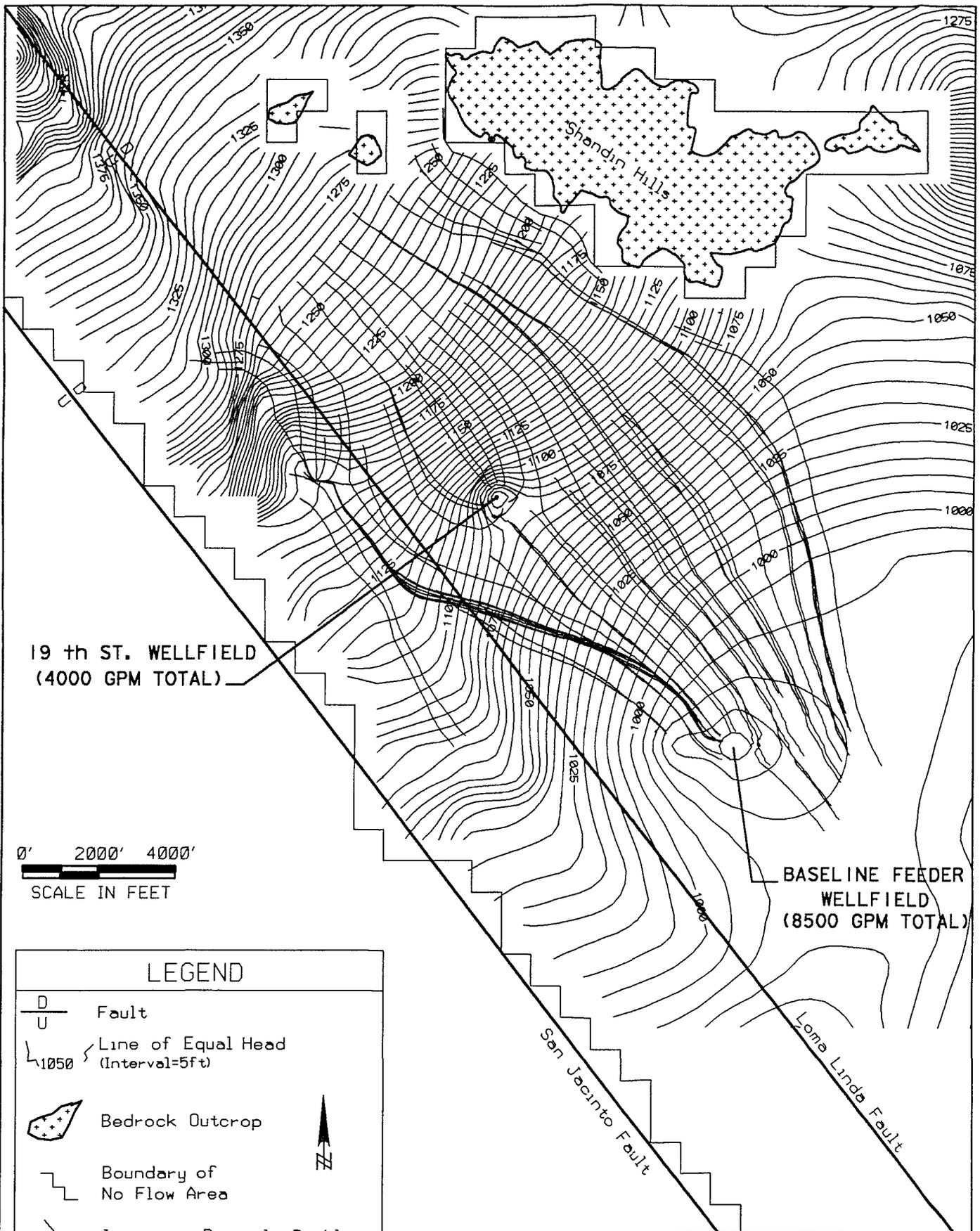
INPUT AND OUTPUT FILES FOR EXTRACTION SCENARIO NO. 1

Run No.	File Name Extension	Filename	Type of File
57A	BAS	57A.BAS	MODFLOW input file
57A	BCF	57A.BCF	MODFLOW input file
57A	OC	57A.OC	MODFLOW input file
57A	PCG	57A.PCG	MODFLOW input file
57A	RIV	57A.RIV	MODFLOW input file
57A	WEL	57A.WEL	MODFLOW input file
57A	GHB	57A.GHB	MODFLOW input file
57A	EVT	57A.EVT	MODFLOW input file
57A	BCF	57ACELL.BCF	MODFLOW cell-by-cell flow file
57A	RIV	57ACELL.RIV	MODFLOW cell-by-cell flow file
57A	WEL	57ACELL.WEL	MODFLOW cell-by-cell flow file
57A	GHB	57ACELL.GHB	MODFLOW cell-by-cell flow file
57A	EVT	57ACELL.EVT	MODFLOW cell-by-cell flow file
57A	OUT	57A.OUT	MODFLOW output file
57A	UFM	57AHEAD.UFM	MODFLOW unformatted head file
57A	INP	57APATH.INP	PATH3D input file
57A	OUT	57APATH.OUT	PATH3D output file
57A	DAT	P3DCNFG.DAT	PATH3D data file
57A	DAT	P3DPLOT.DAT	PATH3D data file
57A	DAT	P3DFRONT.DAT	PATH3D data file
57A	DAT	P3DCAPT.DAT	PATH3D data file
57A	DAT	FRONTXYZ.DAT	PATH3D data file used with SURFER
57A	DAT	PATHXYZ.DAT	PATH3D data file used with SURFER
57A	BLN	PATHXY.BLN	PATH3D data file used with SURFER
57A	BLN	PATHXZ.BLN	PATH3D data file used with SURFER

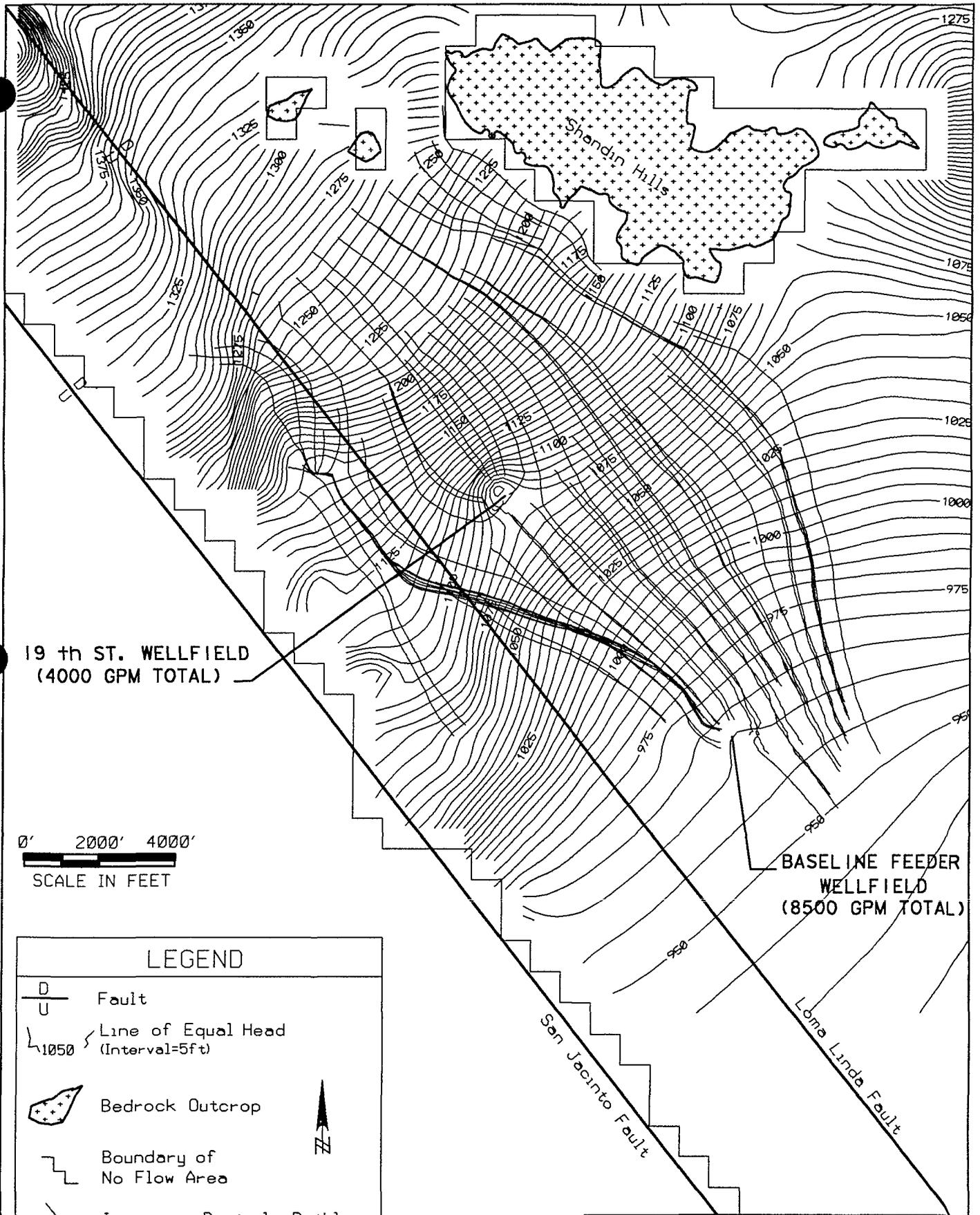
Table A6-5 (Cont'd.)

INPUT AND OUTPUT FILES FOR EXTRACTION SCENARIO NO. 1

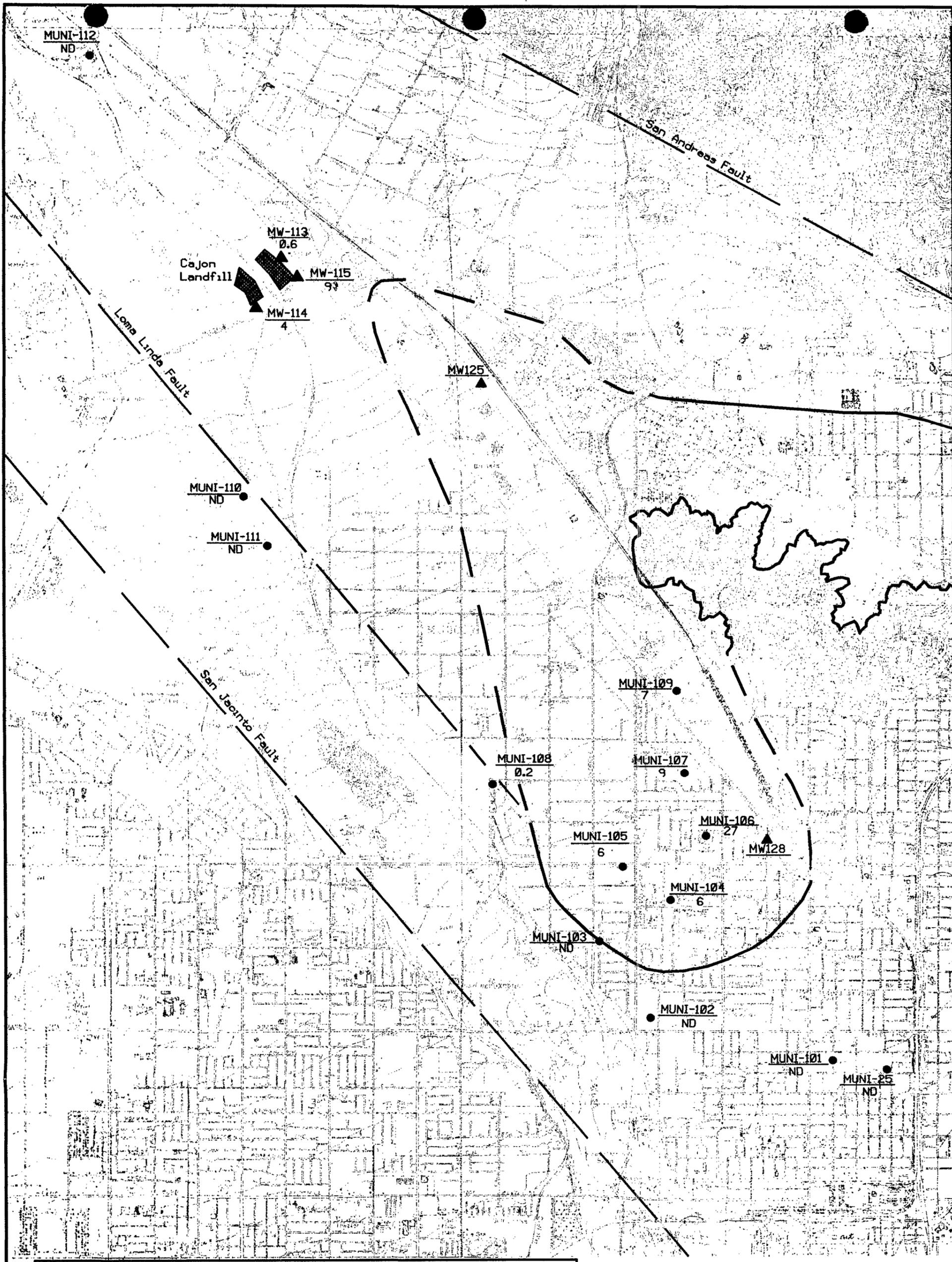
Run No.	File Name Extension	Filename	Type of File
57A	BLN	PATHYZ.BLN	PATH3D data file used with SURFER
57A	GRD	57ACNTR1.GRD	SURFER grid file of head contours
57A	GRD	57ACNTR2.GRD	SURFER grid file of head contours
57A	PLT	57ACNTR1.PLT	SURFER plot file of head contours
57A	PLT	57ACNTR2.PLT	SURFER plot file of head contours
57A	DAT	XTRWELLS.DAT	Data file containing locations of extraction wells



**FIGURE A6-2**  
**HEAD CONTOUR AND PATHLINE PLOT**  
**FOR EXTRACTION SCENARIO NO. 1**  
**LAYER 1 (UPPER AQUIFER)**



**FIGURE A6-3**  
**HEAD CONTOUR AND PATHLINE PLOT**  
**FOR EXTRACTION SCENARIO NO. 1**  
**LAYER 2 (LOWER AQUIFER)**



LEGEND



Approximate Extent  
Groundwater Contamination,  
K. Mayer EPA

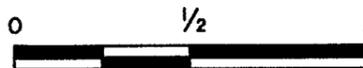
Monitoring Wells  
Municipal Supply Wells

--- Fault

Detection Limit = 0.2 ug/l

ND = No Detections

Note: All Detections in ug/l



SCALE IN MILES



Base Map: USGS San Bernardino Quad

URS Consultants, Inc.  
Sacramento, Ca

MUSCOY PLUME OU RI/FS REPORT  
NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE

FIGURE A6-4

PCE CONCENTRATIONS

1 The following two groups of existing water-supply wells within the Muscoy Plume OU captured  
2 imaginary particles during the simulation and, therefore, may have an influence on the plume.

3 1) The 19th Street wellfield captured particles on the western side of the plume.

4 2) The Baseline Feeder wellfield also captured particles near the leading edge of the plume.

5 The 19th Street wellfield contained very small amounts of contamination. The Baseline Feeder wellfield  
6 reportedly has had no detectable contamination to date.

7 Based on the present configuration of the model and pumping values from 1987-1991 data, the most  
8 conservative model projections estimate that the Muscoy plume edge will reach the Baseline Feeder  
9 wellfield area circa 2003. This estimate does not consider contaminant retardation nor, on the other hand,  
10 that actual groundwater velocities may differ from the average groundwater velocity here. The details  
11 of the calculation of average groundwater velocity are presented in Section 4.0.

### 12 3.2.2 Extraction Scenario No. 2

13 This extraction scenario was simulated using the existing water-supply wells including the 19th Street  
14 wellfield (No. 1 and No. 2 19th Street wells). The pumping rate used for the 19th Street wellfield was  
15 as follows:

- 16 ■ For the 5-year period between January 1986 through December 1990, actual (normal)  
17 pumping rates were used; and
- 18 ■ For the next 30 years, January 1991 through December 2020, the actual 5-year pumping rates  
19 were repeated every 5 years. For the purpose of this extraction scenario, no pumping from  
20 the Baseline Feeder wellfield was assumed.

21 Table A6-6 gives the locations of the extraction areas and their pumping rates used in the simulation run.  
22 Figures A6-5 and A6-6 show the head contours and pathlines of the imaginary particles for layers 1 and  
23 2, respectively. A few of the particles were captured by existing wellfields. Most of the particles were  
24 not captured.

### 25 3.2.3 Extraction Scenario No. 3

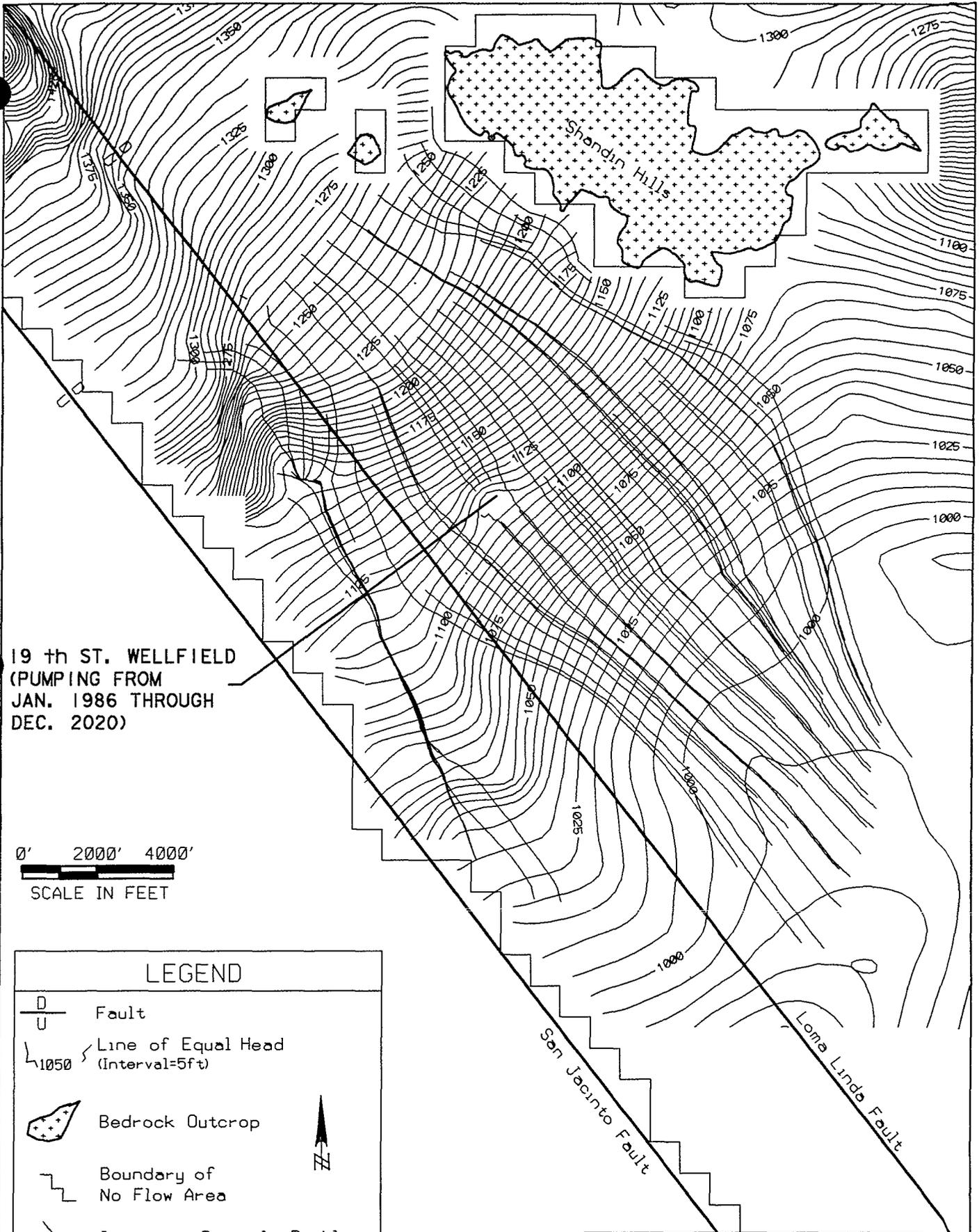
26 This extraction scenario consisted of extraction from the 19th Street wellfield and three extraction areas  
27 located near the downgradient edge of the plume. The extraction from the 19th Street wellfield was as  
28 follows:

- 29 ■ For the 5-year period between January 1986 to December 1990, normal pumping rates were  
30 used; and
- 31 ■ For the next 30 years, constant daily pumping of 1,500 gpm from each of the 19th Street No.  
32 1 and No. 2 wells was used.

Table A6-6

EXTRACTION AREA LOCATIONS & PUMPING RATES  
 FOR EXTRACTION SCENARIO NO. 2 (RUN 56A)

Extraction Area	Model Cell (i,j,k)	Pumping Ratio		Pumping Rate (gpm)
		Layer 1	Layer 2	
19th St. No. 1	(35,17,1) (35,17,2)	0.63	0.37	Actual (Normal) Pumping
19th St. No. 2	(35,17,1) (35,17,2)	0.75	0.25	Actual (Normal) Pumping

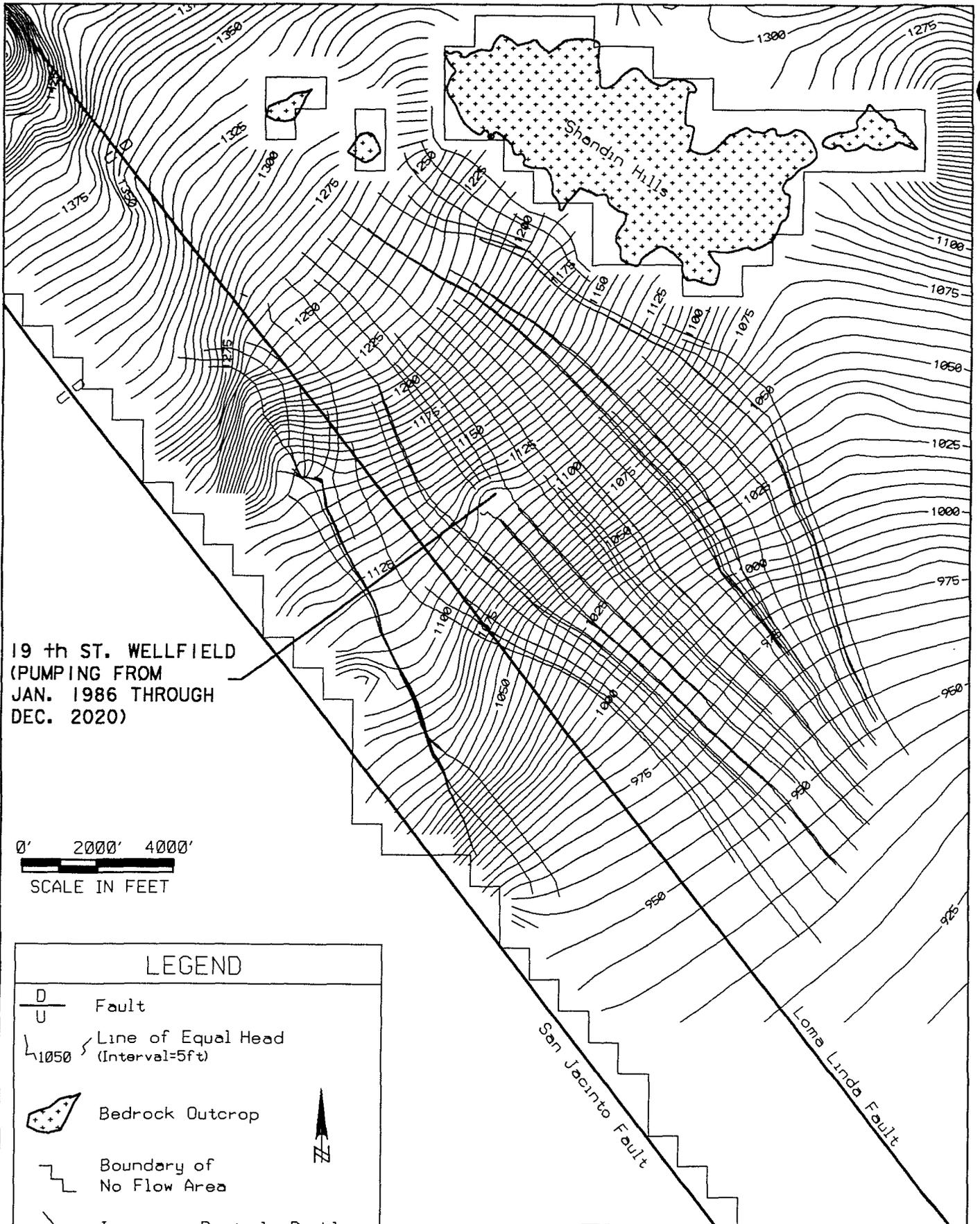


19 th ST. WELLFIELD  
(PUMPING FROM  
JAN. 1986 THROUGH  
DEC. 2020)

0' 2000' 4000'  
SCALE IN FEET

LEGEND	
	Fault
	Line of Equal Head (Interval=5ft)
	Bedrock Outcrop
	Boundary of No Flow Area
	Imaginary Particle Pathline

FIGURE A6-5  
HEAD CONTOUR AND PATHLINE PLOT  
FOR EXTRACTION SCENARIO NO. 2  
LAYER 1 (UPPER AQUIFER)



**FIGURE A6-6**  
**HEAD CONTOUR AND PATHLINE PLOT**  
**FOR EXTRACTION SCENARIO NO. 2**  
**LAYER 2 (LOWER AQUIFER)**

1 The extraction in the three other extraction areas were:

- 2       ▪ No pumping the first 5-year period; and
- 3       ▪ For the next 30 years, constant daily pumping of 1,000, 1,500, and 1,500 gpm from the three
- 4       extraction areas.

5 Table A6-7 gives the locations of the extraction areas and their pumping rates used in the simulation run.  
6 Figures A6-7 and A6-8 show the head contours and pathlines of imaginary particles for layers 1 and 2,  
7 respectively. Most of the imaginary particles were captured by the three extraction areas and the 19th  
8 Street wellfield; however, few imaginary particles south of the three extraction areas were not captured.  
9 Also, a few particles escaped through the space between two extraction areas.

#### 10 **3.2.4     Extraction Scenario No. 4**

11 This extraction scenario consisted of extraction from the 19th Street wellfield and three extraction areas  
12 located near the downgradient edge of the plume. The location of the three extraction areas was changed  
13 so that these extraction areas were situated closer to 19th Street wellfield. The extraction for the 19th  
14 Street wellfield was as follows:

- 15       ▪ For the 5-year period between January 1986 to December 1990, normal pumping rates were
- 16       used; and
- 17       ▪ For the next 30 years, constant daily pumping of 1,500 gpm from each of 19th Street No.
- 18       1 and No. 2 wells was used.

19 The extraction in the three extraction areas were:

- 20       ▪ No pumping the first 5-year period; and
- 21       ▪ For the next 30 years, constant daily pumping of 1,000, 2,000 and 1,000 gpm from the
- 22       extraction areas.

23 Table A6-8 gives the locations of the extraction areas and their pumping rates used in the simulation run.  
24 Figures 12-9 and 12-10 show the head contours and pathlines of imaginary particles for layers 1 and 2,  
25 respectively. Most of the imaginary particles were captured by the three extraction areas and the 19th  
26 Street wellfield; however, a few imaginary particles near the south and one particle north of the three  
27 extraction areas were not captured.

#### 28 **3.2.5     Extraction Scenario No. 5**

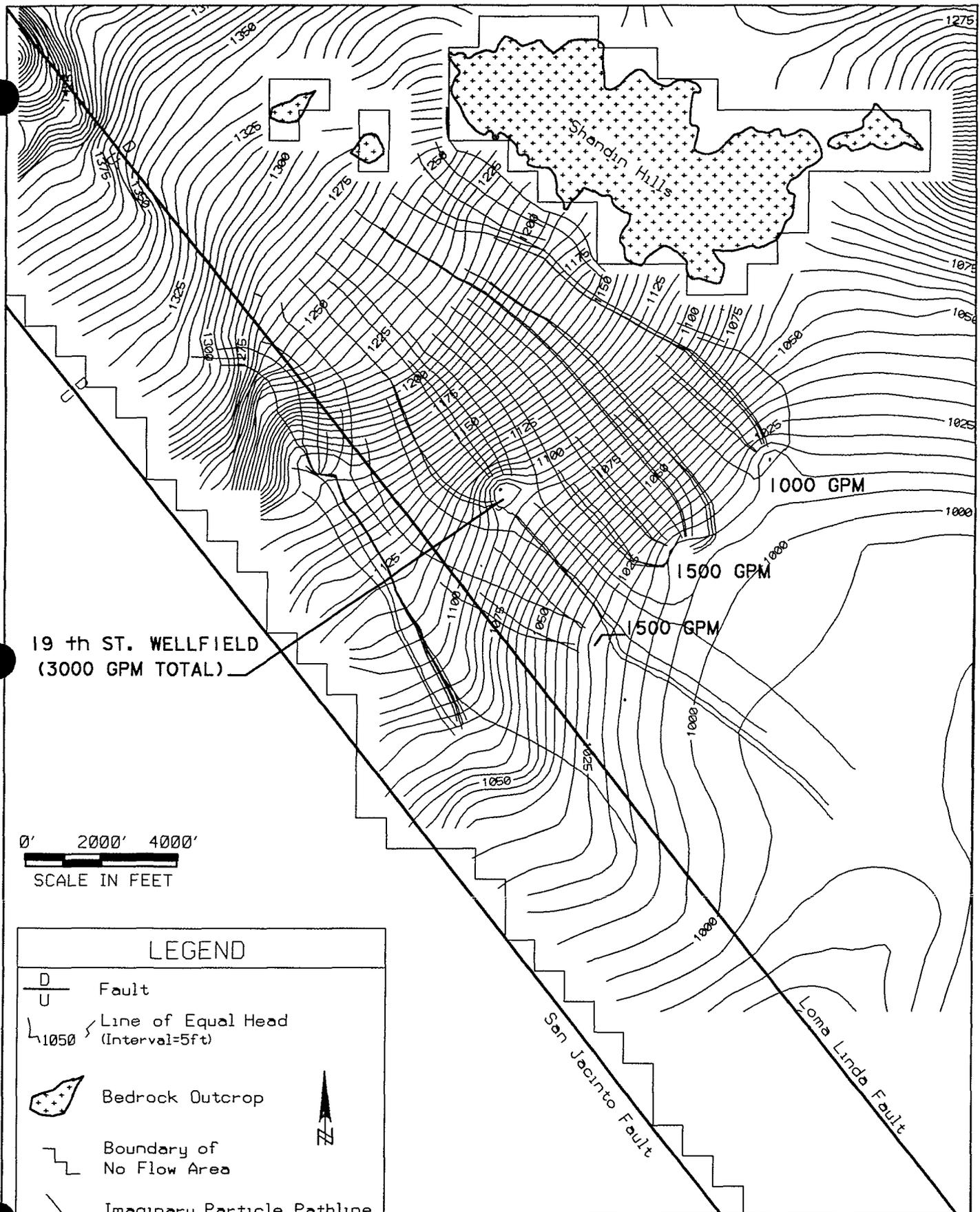
29 Extraction scenario no. 5 consisted of extraction from 19th Street wellfield and four extraction areas  
30 located near the downgradient edge of the plume. The extraction from the 19th Street wellfield was as  
31 follows:

- 32       ▪ For the 5-year period between January 1986 to December 1990, normal pumping rates were
- 33       used; and

Table A6-7

**EXTRACTION AREA LOCATIONS & PUMPING RATES  
 FOR EXTRACTION SCENARIO NO. 3 (RUN 58D)**

Extraction Area	Model Cell (i,j,k)	Pumping Ratio		Pumping Rate (gpm)
		Layer 1	Layer 2	
19th St. No. 1	(35,17,1) (35,17,2)	0.63	0.37	1,500
19th St. No. 2	(35,17,1) (35,17,2)	0.75	0.25	1,500
New Ext. Well	(34,26,1) (34,26,2)	0.33	0.67	1,000
New Ext. Well	(37,23,1) (37,23,2)	0.33	0.67	1,500
New Ext. Well	(40,20,1) (40,20,2)	0.33	0.67	1,500



**FIGURE A6-7**  
**HEAD CONTOUR AND PATHLINE PLOT**  
**FOR EXTRACTION SCENARIO NO. 3**  
**LAYER I (UPPER AQUIFER)**